REMARKS

Claims 1-46 are pending in the application. In the Office Action at hand, Claims 1-23 are rejected, and Clams 24-46 are withdrawn from consideration.

Claims 1 and 2 are rejected under 35 U.S.C. Section 102(e) as being anticipated by WO 02/26378. In addition, Claims 1, 3, 5, 19 and 21 are rejected under 35 U.S.C. §102(b) as being anticipated by WO 93/11855. Claims 1-3, 9 and 19-21 are rejected under Section 102(b) as being anticipated by Etievant. Claims 1, 4, 5, 10, 17-19, 22 and 23 are rejected under Section 102(b) as being anticipated by JP 11-278802. Claims 1, 2, 19, 20, 22 and 23 are rejected under Section 102(b) as being anticipated by Bromberg. Claims 6-8 are rejected under 35 U.S.C. §103(a) as being unpatentable over WO 02/26378, WO 93/11855, Etievant, JP 11-278802 and Bromberg. Claims 2, 11, and 20 are rejected under Section 103(a) as being unpatentable over JP 11-278802. Claims 3, 12-14 and 21 are rejected under Section 103(a) as being unpatentable over JP 11-278802 in view of Hemingway. Finally, Claims 15 and 16 are rejected under Section 103(a) as being unpatentable over JP 11-278802 in view of Hemingway and WO 02/26378. In response to the Section 102(e), 102(b) and 103(a) rejections, the Applicants respectfully submit that Claims 1-23, as amended, are not anticipated or obvious in view of WO 02/26378, WO 93/11855, Etievant, JP 11-278802, Bromberg and Hemingway. Reconsideration is respectively requested.

Claim 1 recites a gas separation apparatus including an irradiation chamber for receiving a gas. An irradiation device is included for irradiating the gas within the irradiation chamber for causing molecules of the gas to break apart into larger and smaller constituent components. A separation arrangement is included for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber. A first outlet is included for removing the smaller constituent components from the irradiation chamber.

Claim 10, as amended, recites a gas separation apparatus in which the irradiation chamber includes a rotary member capable of rotating about an axis. Rotation of the rotary member separates the larger and smaller constituent components from each other within the

irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber, and causes the larger constituent components to move radially outwardly relative to the axis of the rotary member and the smaller constituent components. Claim 19, as amended, recites a gas separation apparatus including a waveform generator for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber. Claims 10 and 19 have been amended to recite the limitation found in Claim 1, as originally filed, "separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber".

In embodiments of the claimed invention, the irradiation device can be configured to sufficiently irradiate gas in the irradiation chamber, such as hydrocarbon gas to cause the gas to break apart into larger constituent components such as including carbon, and smaller constituent components, such as hydrogen and/or hydrogen ions. For example, an electron beam device as claimed in Claim 3 can break apart the gas in the irradiation chamber in an effective and compact manner. In addition, by having a separation arrangement for applying forces within the irradiation chamber on the larger and smaller constituent components for forcing the constituent components toward different regions of the irradiation chamber, separation of the constituent components can continuously occur within the irradiation chamber while at the same being irradiated. This can allow separation in a quick, efficient and compact manner. Separation can be caused for example, by centrifugal forces with a rotary member, or electrical or magnetic forces with a wave form generator, applied within the irradiation chamber or combinations thereof.

In contrast, WO 02/26378 discloses in Figs. 1 and 2, the treatment of CH_4 or H_2S with a corona discharge within a reactor 14. The treatment of the CH_4 forms hydrogen (H_2) 18 and C_2H_2, and the treatment of H_2S forms hydrogen (H_2) 18 and sulfur (S) 13, which can be separated from each other by allowing the hydrogen (H_2) 18 to be filtered and passively separated through a membrane 16 and removed through outlets exiting the reactor 14. It would appear that a mixture of hydrogen (H_2) 18 and C_2H_2 or sulfur (S) 13 extends throughout the reactor 14, and membrane 16 merely allows only the H_2 to exit the reactor 14 through the

hydrogen outlets, but not the C_2H_2 or S. As a result, there are no forces applied to the H_2 and C_2H_2 or S within the reactor 14 which separate the H_2 and C_2H_2 or S from each other to different regions of the reactor 14. Instead, the separation of the H_2 occurs passively while exiting the reactor 14 and the membrane is not a separation arrangement as recited in the claimed invention.

Accordingly, Claims 1 and 2 are not anticipated by WO 02/26378 since the reference does not teach or suggest "a separation arrangement for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber," as recited in base Claim 1. Reconsideration is respectively requested.

WO 93/11855 discloses the irradiation of oxides of nitrogen and sulfur flowing through a duct with an electron beam, which causes the oxides to react with lime, ammonium or water, and form solid compounds having larger molecules than the original oxides. The solids are collected on collection sheets 5 with an electric or magnetic field at a location that is downstream and away from the irradiation region. There is no separation of any components to different regions within the irradiation region that is located below the electron source 1.

Accordingly, Claims 1, 3, 5, 19 and 21, as amended, are not anticipated by WO 93/11855, since the reference does not teach or suggest an irradiation device causing "molecules of the gas to break apart into larger and smaller constituent components", or "a separation arrangement for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber," as recited in base Claim 1, or "a waveform generator for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber", as recited in base Claim 19, as amended. Reconsideration is respectfully requested.

Etievant discloses the use of electrical or corona discharges between electrodes, or microwaves for treating fuel gases. A membrane located at the periphery of the irradiation region allows the passive separation and removal of hydrogen exiting the irradiation region. There is no separation within the irradiation region as claimed.

Accordingly, Claims 1-3, 9 and 19-21, as amended are not anticipated by Etievant since Etievant does not teach or suggest "a separation arrangement for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components towards different regions of the irradiation chamber," as recited in base Claim 1, or "a waveform generator for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber," as recited in base Claim 19, as amended. Reconsideration is respectively requested.

JP 11-278802 discloses a gas reactor 100 including rotor 102 with blades 103 having catalyst layers 104. Electrical power is applied between rotor 102 and an electrode 105 which forms a glow discharge to convert a CH_4 and CO_2 gas mixture A, into a gas mixture A^1 of H_2 and CO_2. The gas mixture A^1 exits together through the same outlet 111 (FIG. 1). Rotation of the rotor 102 therefore appears to mix the gases rather than to force different components to different regions of the irradiation region.

Accordingly, Claims 1, 4, 5, 10, 17-19, 21 and 23, as amended, are not anticipated by JP 11-278802 since the reference does not teach or suggest "a separation arrangement for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components towards different regions of the irradiation chamber," as recited in base Claim 1, or rotation of a "rotary member for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber, and causing the larger constituent components to move radially outwardly relative to the axis of the rotary member and the smaller constituent components", as recited in base Claim 10, as amended, or "a waveform generator for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber," as recited in base Claim 19, as amended. Reconsideration is respectively requested.

Bromberg discloses in FIGs. 1 and 3, a plasmatron fuel cell system including a plasmatron 10 having an annode 30 and cathode 32 that creates a plasma arc 38 for treating

hydrocarbon fuel 12 and producing a hydrogen rich gas mixture, which can be introduced to a fuel cell 16. Referring to FIG. 10, the gas mixture exiting the plasmatron 10 can be sent to and separated in a hydrogen separator 56 for separating hydrogen gas from carbon monoxide and carbon dioxide.

Accordingly, Claims 1, 2, 19, 20, 22 and 23, as amended, are not anticipated by Bromberg since Bromberg does not teach or suggest "a separation arrangement for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components towards different regions of the irradiation chamber," as recited in base Claim 1, or "a waveform generator for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber," as recited in base Claim 19, as amended. Reconsideration is respectively requested.

In view of the discussion above, dependent Claims 6-8, which are dependent upon base Claim 1, are also not obvious in view of WO 02/06378, WO 93/11855, Etievant, JP 11-278802, and Bromberg, and dependent Claims 2, 11 and 20, which are dependent upon base Claim 1 and base Claim 19, as amended, are not obvious in view of JP 11-278802. Reconsideration is respectively requested.

Hemingway discloses in FIGs. 1 and 2 a parallel plate non-thermal plasma reactor 10 having electrodes 12, 14 and 16 for generating a corona volume and a non-thermal plasma for treating gas such as diesel exhaust, for example, for converting NO_x to N_2. Hemingway does not separate components towards different regions of a irradiation chamber. Column 2 lines 40-48 disclose that non-thermal plasmas can be generated by the injection of electrons into gas by an electron beam.

Accordingly, Claims 3, 12-14 and 21 are not obvious in view of JP 11-278802 and Hemingway, since neither reference, alone or in combination, teaches or suggests "a separation arrangement for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber", as recited in base Claim 1, or rotation of a "rotary

member for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber, and causing the larger constituent components to move radially outwardly relative to the axis of the rotary member and the smaller constituent components", as recited in base Claim 10, as amended, or "a waveform generator for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber", as recited in base Claim 19, as amended. Reconsideration is respectively requested.

Furthermore, in view of the discussion above, Claims 15 and 16 are not obvious in view of JP 11-278802, Hemingway and WO 02/26378, since none of the references, alone or in combination, teach or suggest rotation of a "rotary member for separating the larger and smaller constituent components from each other within the irradiation chamber by forcing the larger and smaller constituent components toward different regions of the irradiation chamber, and causing the larger constituent components to move radially outwardly relative to the axis of the rotary member and the smaller constituent components," as recited in base Claim 10, as amended. Therefore, Claims 1-23, as amended, are in condition for allowance. Reconsideration is respectively requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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